Review for Exam 3

Class Weeks, topics and dates	Book Chapters	Lab numbers and Topics
Week 1 1D motion and units 1/17	Ch.1.1-6 and 2	Introduction
Week 2 2D motion , vectors 1/23	Ch. 1.7-9 and 3.1-3	109. 1 D motion
Week 3 Forces + exam 1 review; 1/30	Ch. 4	111. Projectile motion
Exam 1 1D&2D motion, units,vectors; 2/6	On Weeks 1-2	
Week 4 Linear static forces 2/6	Ch. 5.1 and 11	112 Newton's 2nd
Week 5 Friction 2/13	Ch. 5.2-3	103 Linear statics
Week 6 Work and Kinetic Energy 2/20	Ch. 1.10 and 6	106 Friction
Week 7 Potential and conservation of Energy + exam 2 review 2/27	Ch. 7	New: Work and Kinetic Energy
Exam 2 Forces, friction, energy 3/6	On weeks 3-6	
Week 8 Momentum and Collisions 3/6	Ch. 8	125 Conservation of Energy
Spring break 3/13		
Week 9 Circular motion 3/20	Ch. 3.4 and 5.4	126 Conservation of momentum
Week 10 Torque, Moment of Inertia 3/27	Ch. 1.10 and 9	114 Circular motion
Week 11 Rotational Motion 4/3	Ch. 10.1-6	127 Torque and rotation
Exam 3 on conservation, circular motion & torque 4/10	On weeks 7-11	
Week 12 Rotation statics+Exam 3 rev. 4/10	Ch. 11.1-3	120 Conservation angular energy
Week 13 Fluid Mechanics 4/17	Ch. 12.1-5	121 rotation static forces
Week 14 Universal Gravitation 4/24	Chap. 13	7 Archimedes' Principle
Review of the course 5/1		
Classes end 5/2		
Final exam tbd	Weeks 1-14	

Wheel slows down

A wheel decelerates at a rate of 0.3 Radians/s^2 It turns 50 times and then stops. Long does it take?

$\alpha=(\omega-\omega_0)/t$
$=-0.3\ m/s^2$

$\omega_{ave}=2\pi\ 50/t=\omega_0/2$
$\omega_0=628/t$

$-0.3=(0-630/t)/t$
$t=sqrt(630/.3)=45s$

Rolling ring

A disk rolls straight down a hill and is going 8 m/s at the bottom. How high is the hill?

$$mgh=mvv/2+Iww/2$$

$$I=mRR/2;\ w=v/R \Rightarrow Iww=.5mRRvv/RR$$

$$mgh=mvv/2+mvv/4=mvv(3/4)$$

$$h=(1/g)vv(3/4)=(1/9.8)(64)(3/4)=5$$

Yoyo

A person holds one end of a string and the other end is wound around a disk. The initial angular acceleration of the disk is 130 radians/s^2. What is the radius of the disk?

mg-F=ma

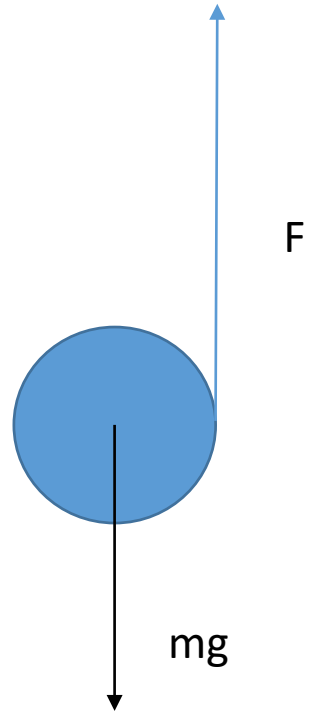
Torque=FR=I α = .5 m RR *a/R

F=.5ma

mg-.5ma=ma

g=1.5a=1.5αR

R=g/1.5α=9.8/(1.5*130)=0.05 m



Falling elevator

An elevator falls without friction. It's mass is 2000kg, the counter weight is 1900 kg and the pulley is a disk of mass 400 kg and radius 2 m. When it hits, its speed is 2 m/s. How far did it fall?

$(M-m)gh=1/2\ (M+m)\ vv + ½I\omega\omega$

$I=1/2\ M'RR; \qquad \omega=v/R$

$(M-m)gh=1/2\ (M+m)\ vv + ¼\ M'vv$

$h= ½\ (vv)(M+m+\ M'/2)/g(M-m)$

$=.5*\ 4*(2000+1900+400/2)/9.8*(100)$

$=8$

Conservation of momentum

- A ring that is dropped on a rotating cylindrical table. The ring is centered on the table and oriented with the same axis as the table. The ring has a moment of inertia of 0.04kg.m^2. The ring is initially not rotating and the table is rotating at 15 radians/s. The table has a radius of 0.33m and the velocity of a point on the edge of the table is 1.0 m/s after the drop? What is the moment of inertia of the table?

a. 0.10
b. 0.56
c. 0.24
d. 0.03
e. 0.01

Momentum: Table+0= both

$I_t*\omega_t+0=(I_t+I_r)*\omega$

$I_t=I_r*\omega/(\omega_t-\omega)$

Also need: $\omega=v/R=1/.33=3$

$I_t=0.04*3/(15-3)=0.01$

1. Linear and angular acceleration

- A merry-go-round (a disk) is accelerating at 3 Radians/s^2. A woman feels a linear acceleration of 15 m/s^2. How far from the center is she standing?
- $a=\alpha r \Rightarrow r=15/3=5$

Angular acceleration

- A disk starts from rest and speeds up to an angular velocity of 3 radians/s in 30 s. What is its angular acceleration?

- $\alpha=\omega/t$ => 3/30=0.1 radians/s^2

Moment of inertia

- A disk is rotating around its center axis. The moment of inertia of the disk is 32 kg m^2. The mass of the disk is 4kg. What is the radius?
- $I=mr^2/2 \Rightarrow r^2=2I/m \Rightarrow r=4$

R of rotation

As in the lab, 0.1kg mass is held by a spring . It is rotating at an angular velocity of 10 radians/s. Its linear velocity is 1m/s. What is the length of the spring in m?

a. 1

b. 10

c. .01

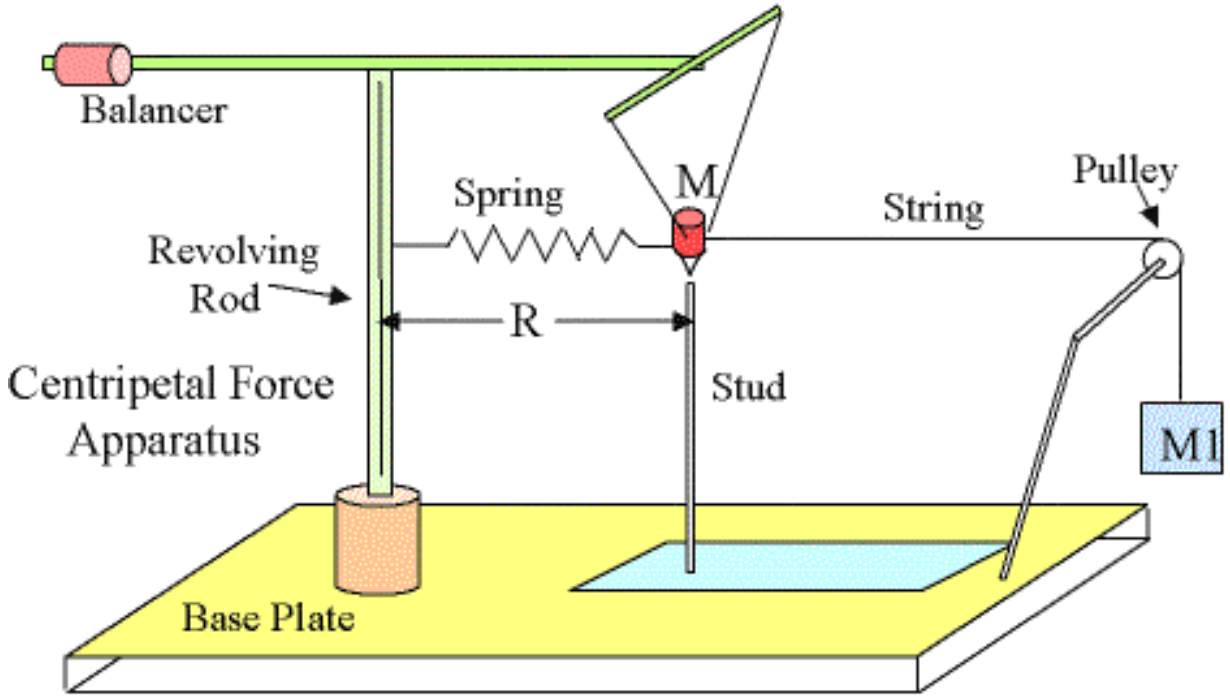
d. 100

e. 0.1

$v=\omega R$

$R=v/\omega$

$=0.1m$

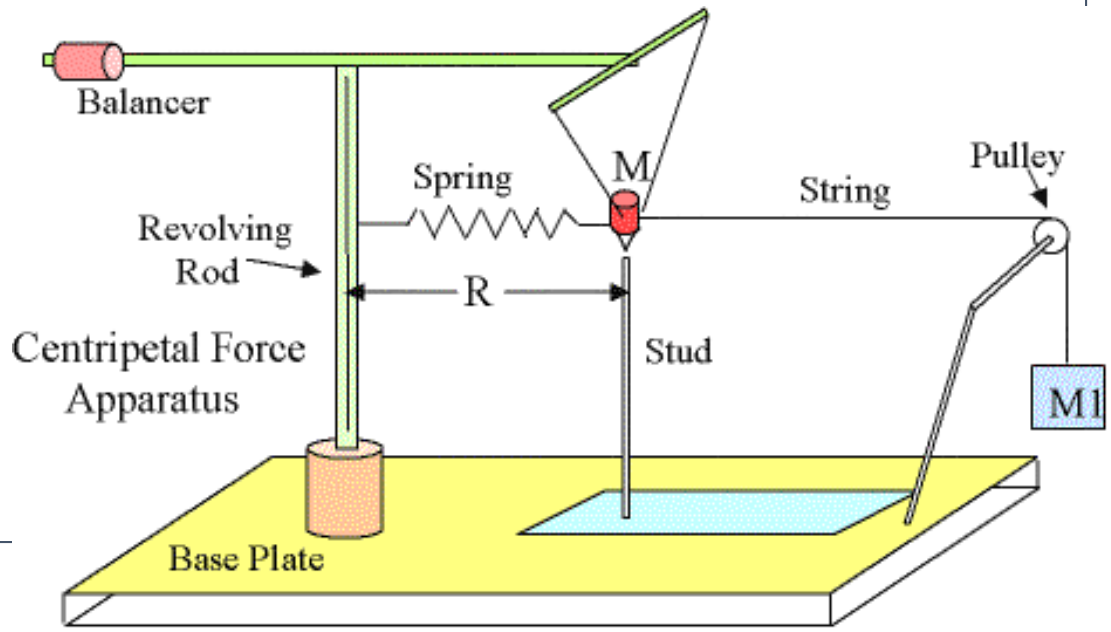


Mass in rotation

- As in the lab, a revolving object is held with a spring. You adjust the radius of rotation to 0.05m. The force on the spring is 0.5N. The linear velocity is 1.6m/s. What is the mass of the weight?

a. 0.02
b. 0.01
c. 0.5
d. 0.25
e. 0.008

$F=ma$
$a=v^2/R$
$m=RF/v^2$
$=0.01$

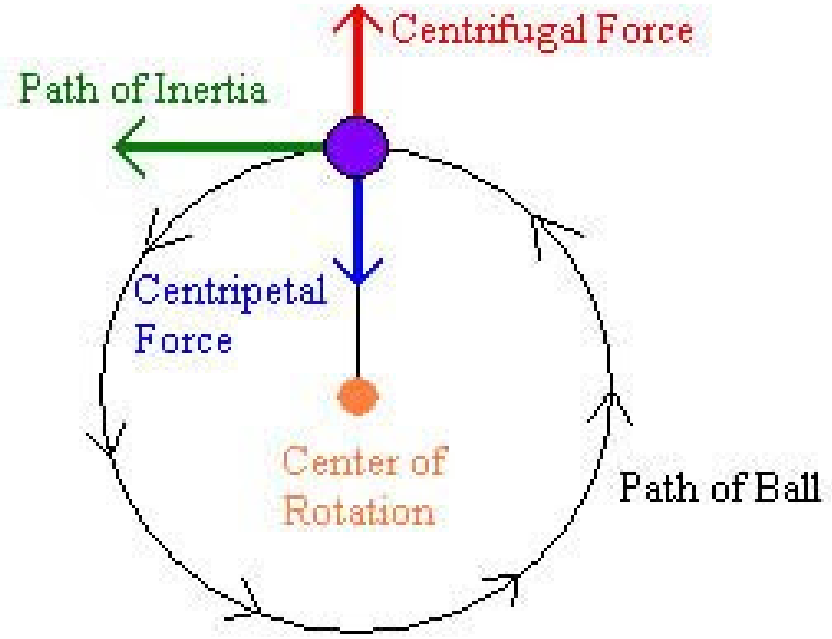


Acceleration in rotation

A mass of 50kg is rotating on a string with a radius of 0.5m and a number of rotations/s of 0.5. What is the centripetal acceleration of the mass?

a. 9.8
b. 2.4
c. 4.9
d. 1.2
e. 10.2

$a=v^2/R$
$v=2\pi\nu R$
$a = 4.9$



Inelastic collision

A car of mass 1/5kg is moving at a velocity +1/4 m/s. It hits a car head on of mass 0.1 kg and velocity -0.5 m/s. They stick together. How fast (in m/s) is the wreck moving just after the collision.

a. 0.25
b. -0.1
c. -0.5
d. +0.1
e. 0

$m_1v_1+m_2v_2=(m_1+m_2)*V$

$.2*.25-.1*.5=0$

Explosion

Two cars are connected by a compressed spring. The spring is released. The car with mass 0.2kg shoots off with velocity 5m/s. The other car goes off with velocity -0.1 m/s. What is the mass (in kg) of the slow car?

a. 5
b. 10
c. 0.1
d. 1
e. 0

0= m1*v1+m2*v2
m2= -m1*v1/v2
=0.2*5/.1 = 10

Dart into toy car

A dart is fired at a speed of 500m/s into a stationary toy car with mass 3.5 kg, on a frictionless, horizontal rail. After the collision, the dart sticks in the car and they move together at 1 m/s. Find the mass of the dart, in kg.

a. 5/100

b. 7/100

c. 2/1000

d. 3.5/1000

e. 7/1000

$mV=(M+m)v$

$m=(M+m)v/V=(3.5)*1/500$

$=3.5/500=7/1000$

Impulse of a glider

A glider of mass 5kg and velocity +2m/s hits the end of a horizontal rail and bounces off in the opposite direction. The collision is inelastic with an average force of -100N and a duration of 0.2 s. What is the final velocity (in m/s)?

a. -22
b. 22
c. -20
d. -2
e. -6

$mv'-mv= Ft$
$mv'=Ft+mv$
$v'=Ft/m+v$
$=-100*0.2/5+2$
$=-2$

Center of mass

3 children are standing on a platform:

1. m=40 kg; R=10i+2j m
2. m=50 kg; R=-2i+3j m
3. m=60 kg; R=3i + -4j m

Where R is relative to the center.

Where is the center of mass of the children?

Impulse of a bullet

A bullet is fired at a speed of 500m/s into a stationary block with mass 5kg, on a frictionless, horizontal surface. After the collision, the bullet gets stuck in the block and they move together at 1 m/s. The mass of the bullet is 0.01 kg. How big is the impulse (in N s) ?

a. 500

b. 0.01

c. -500

d. -.01

e. -5

$(M+m)v-mV=Ft$

$Ft=(5+.01)*1-(0.01)*500$

$=+0.01$